

# Science Gateways for Discrete Event Simulation based on P-GRADE Portal

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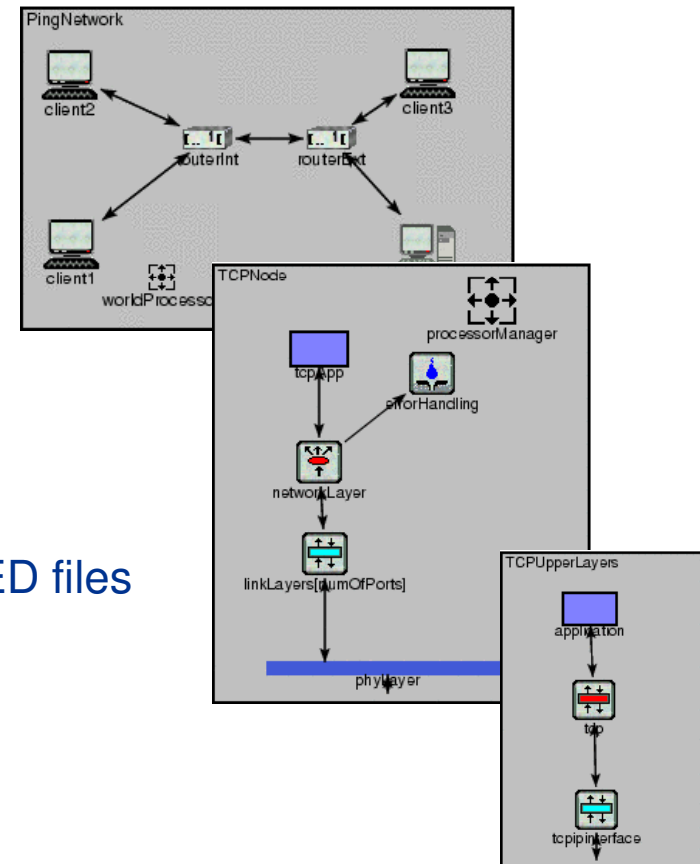
**<https://pgrade-omnet.sztaki.hu>**

**[www.lpds.sztaki.hu/gasuc](http://www.lpds.sztaki.hu/gasuc)**

- **OMNET: discrete event simulation framework**
- **OMNET++ simulations on EGEE with P-GRADE Portal**
- **Science gateways for the OMNET community**
- **Building other science gateways from P-GRADE Portal**

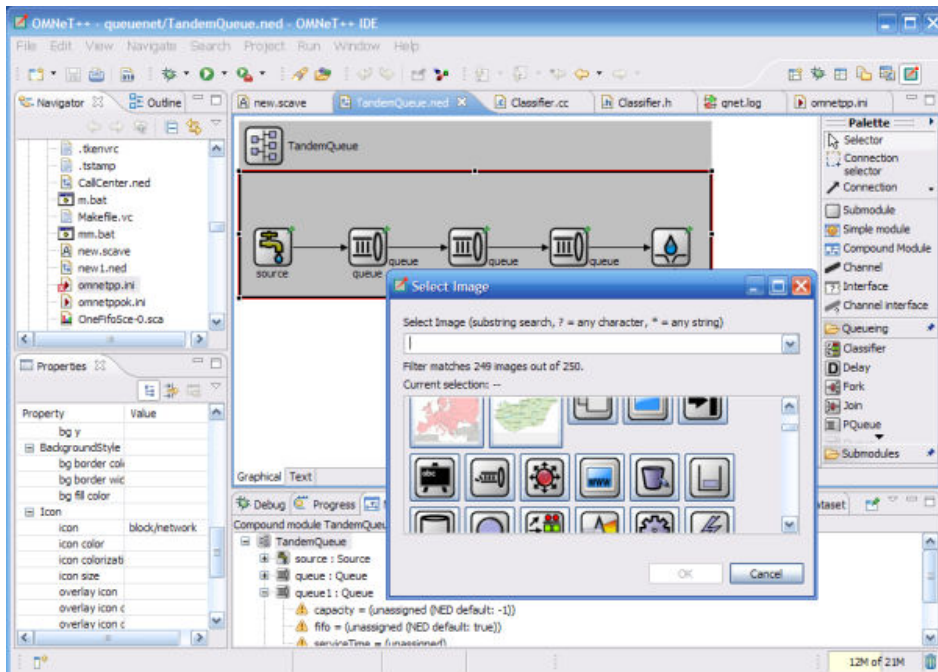
## A generic simulation framework:

- For the simulation of **complex distributed systems**: distributed hardware and software architectures, communication networks, queuing networks,...
  
- An **open environment**
  - Dual licensing:
    - Academic Public License
    - Commercial License
  
- **Vivid academic and commercial community**
  - [www.omnetpp.org](http://www.omnetpp.org)
  
- **OMNET developers**
  - define new modules (network endpoints) in NED files
  - define simulation parameters in INI file



|                               | Modules may represent:   | Messages / events may represent:   |
|-------------------------------|--|--|
| <b>hardware systems</b>       | sensor, controller, disk, interface card, CPU, memory  | signals, commands, disk head movement, interrupts,...  |
| <b>server farm</b>            | application server, web server, daemon process (service), thread, database, database query process | HTTP request, remote method invocation, SQL query,...  |
| <b>business processes</b>     | department, organizational unit, filing cabinet, database, employee, customer,...                  | file or job, email/phone communication, deadline,...   |
| <b>communication networks</b> | host, router, comm. media, protocol layer, application, simulated user, app. session               | protocol header, packet, beginning/end of frame transmission, collision, timer expiry, session start/end,... |
| <b>call centers</b>           | call center, clerk, customer   | start/end phone calls, end of customer's patience (balking),...  |
| <b>queuing systems</b>        | queue, switch,...  | job, beginning/end of processing   |

- **NED file (Network Description Language)**
  - Elementary modules
  - How modules are assembled
  - C code
- **INI file**
  - Simulation configurations
  - Parameter variations
- **Graphical or text editors**



[General]  
cmdenv-express-mode = true

**[Config Ring]**  
description = "a server ring"  
network = RingQueue  
\*\* .source.numJobs = **#{numJobs=5,10,20}**  
\*\* .source.numJobs = 25  
\*\* .serviceTime = exponential(**#{serviceTimeMean=0.5s,1s,2s}**)  
\*\* .apply-default = true  
constraint = \$numJobs!=20 || \$serviceTimeMean<1s  
**repeat = 3**

*Further runs...*

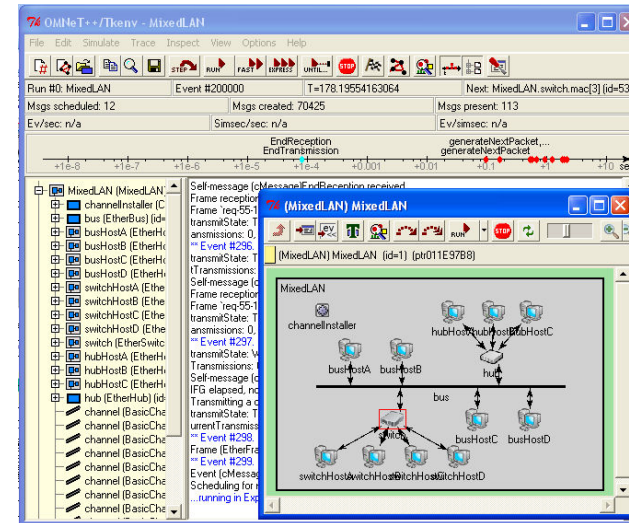
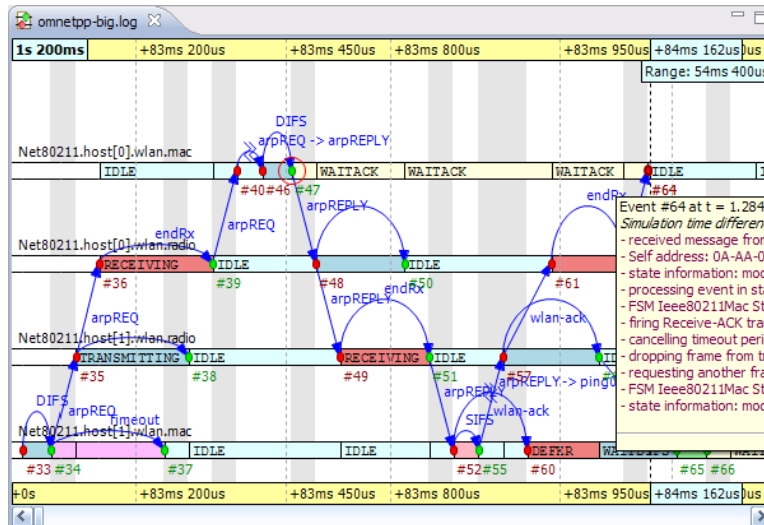
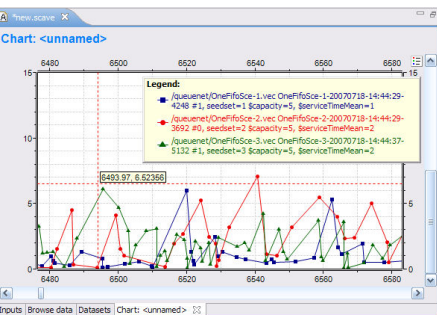
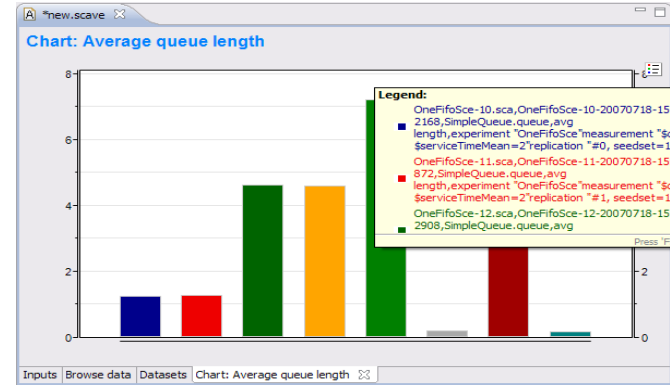
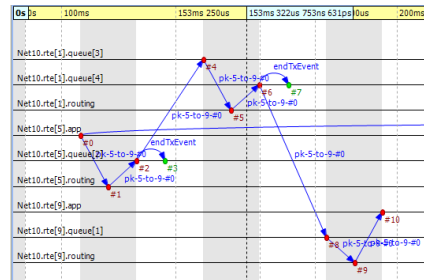
```
//
// Host with an Ethernet interface
//
module EthernetHost {
    parameters: ...
    gates: ...
    submodules:
        app: EtherTrafficGen;
        llc: EtherLLC;
        mac: EtherMAC;
    connections:
        app.out --> llc.hl_in;
        app.in <-- llc.hl_out;
        llc.ll_in <-- mac.hl_out;
        llc.ll_out --> mac.hl_in;
        mac.ll_in <-- in;
        mac.ll_out --> out;
}
```

- **Default organization of experiments:**

| Config entry             | Default value                         |
|--------------------------|---------------------------------------|
| <b>experiment-label</b>  | “ <b>\${configname}</b> ”             |
| <b>measurement-label</b> | “ <b>\${iterationvars}</b> ”          |
| <b>replication-label</b> | “ <b>#\${repetition}, seedset=@</b> ” |
| <b>seed-set</b>          | <b>\${runnumber}</b>                  |

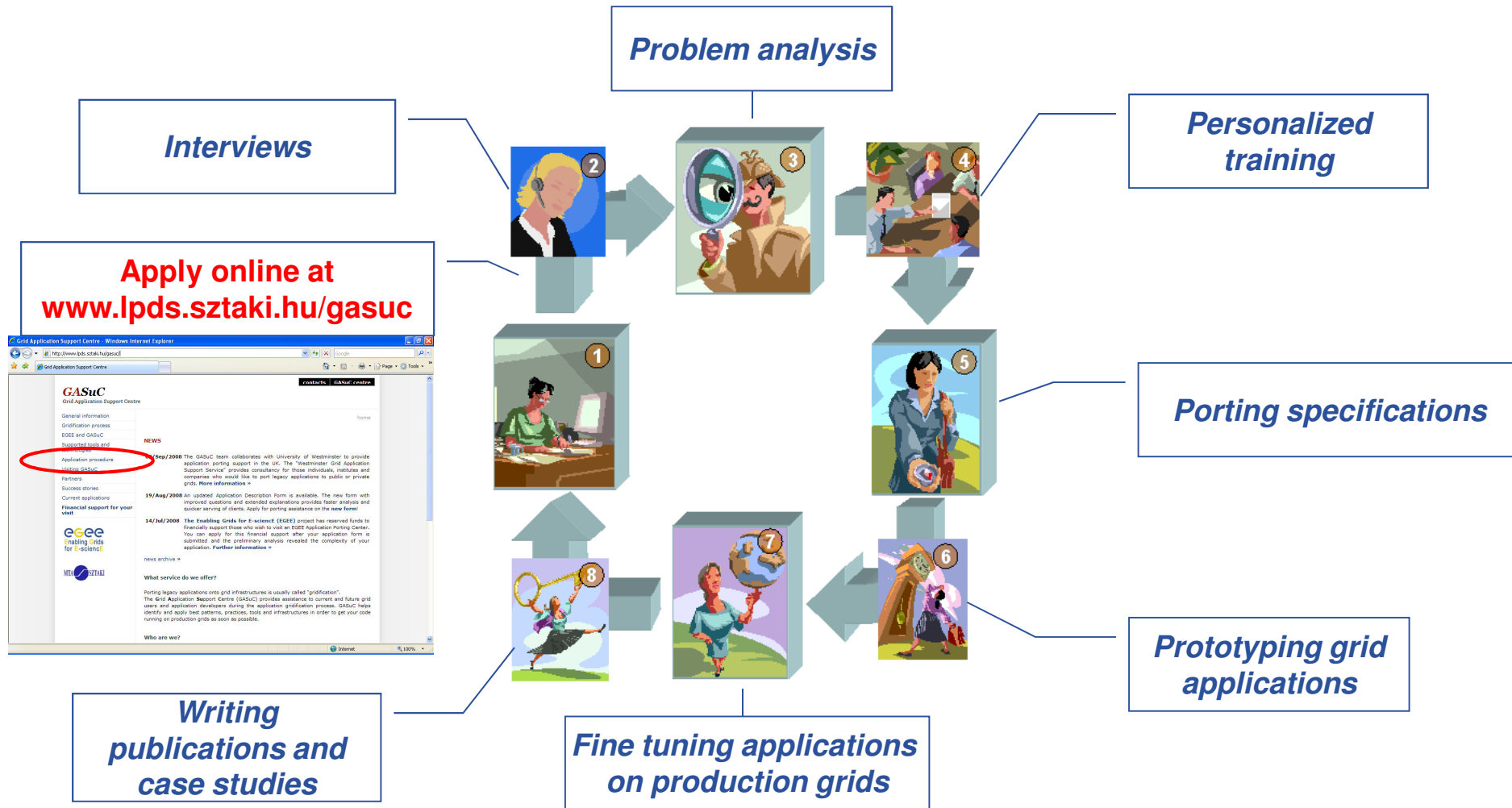
- **Note: by overriding the defaults, many variations are possible. For example:**
  - By specifying an explicit experiment-label, one can group many configurations into one experiment
  - seed-set can be set to `${repetition}` as well

- **vector results:** a sequence of events (*time, value*) pairs
  - typical visualization: line chart
- **scalar results:** statistical or overall values for the simulation
  - typical visualization: bar chart, x-y plot
- **Visualization**
  - OMNeT++'s tools
  - 3rd party tools (R, Matlab, Excel, etc)

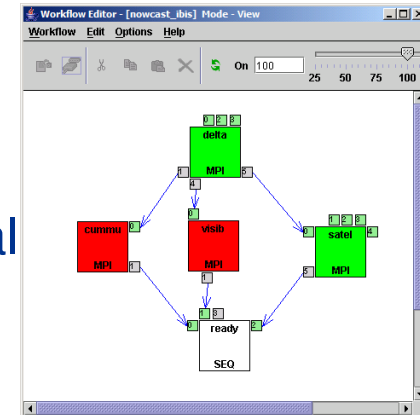
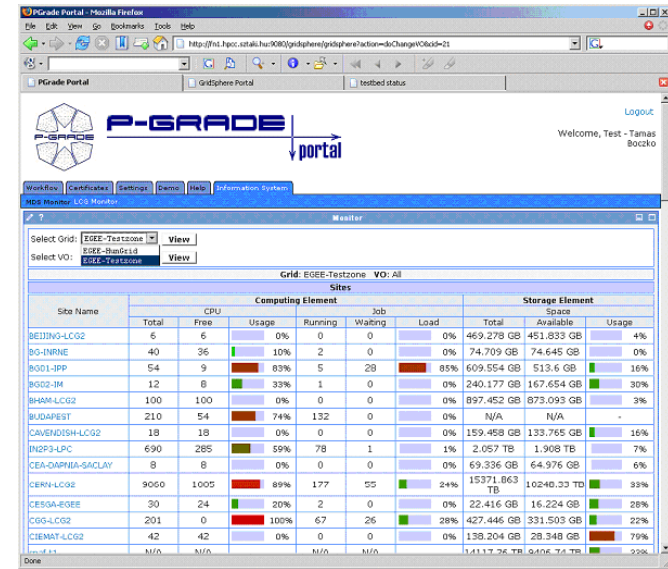


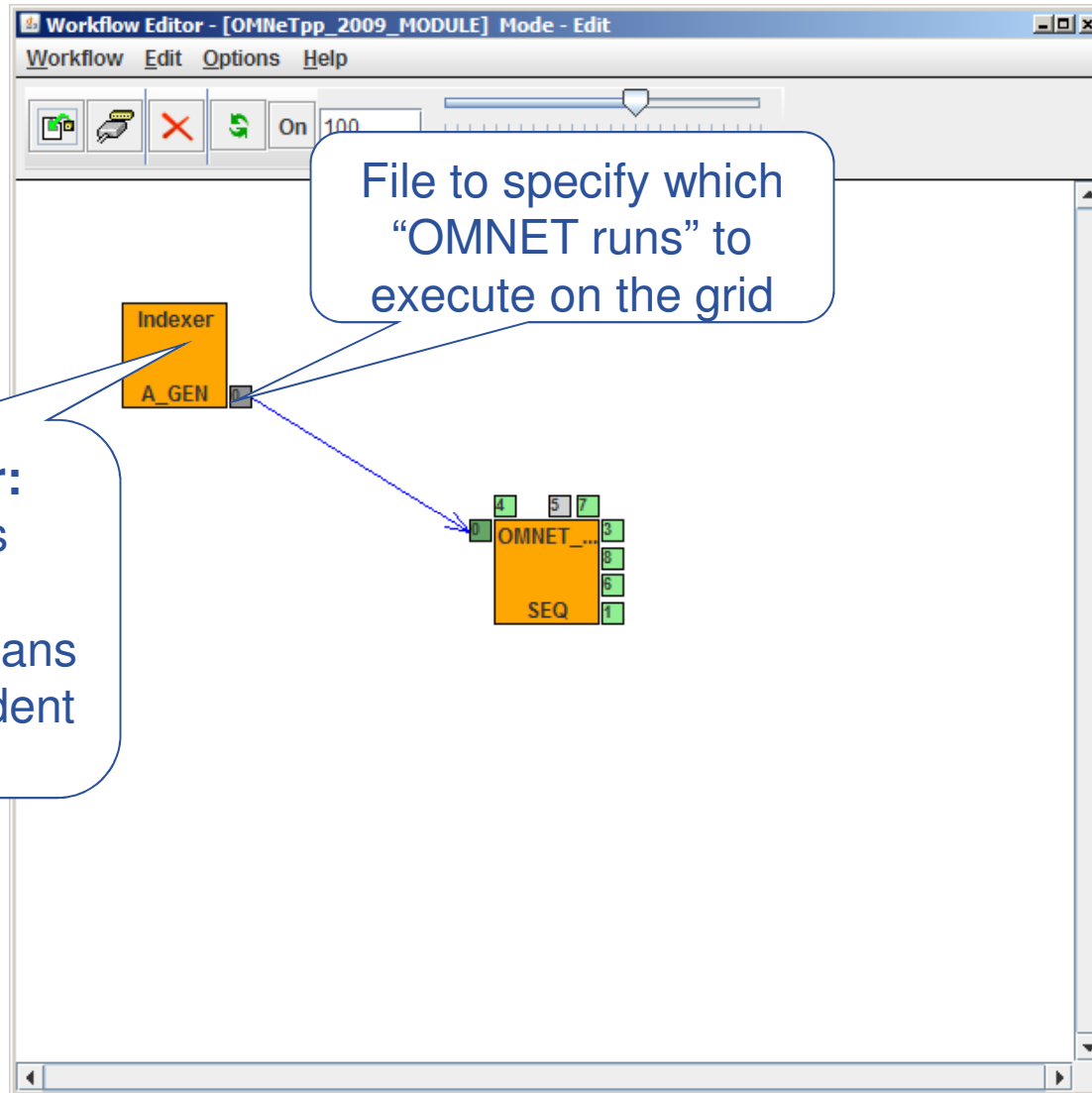
- **Porting *legacy* applications to EGEE**
  - For code that already runs on one machine, on a cluster or on a grid
- **Our service includes**
  - Consultancy
  - Customized training
  - Technology support
  - Email / telephone help desk
  - Coding
- **Generic service for any user / community**
- **More information, stories and application form:**  
**<http://www.lpds.sztaki.hu/gasuc>**

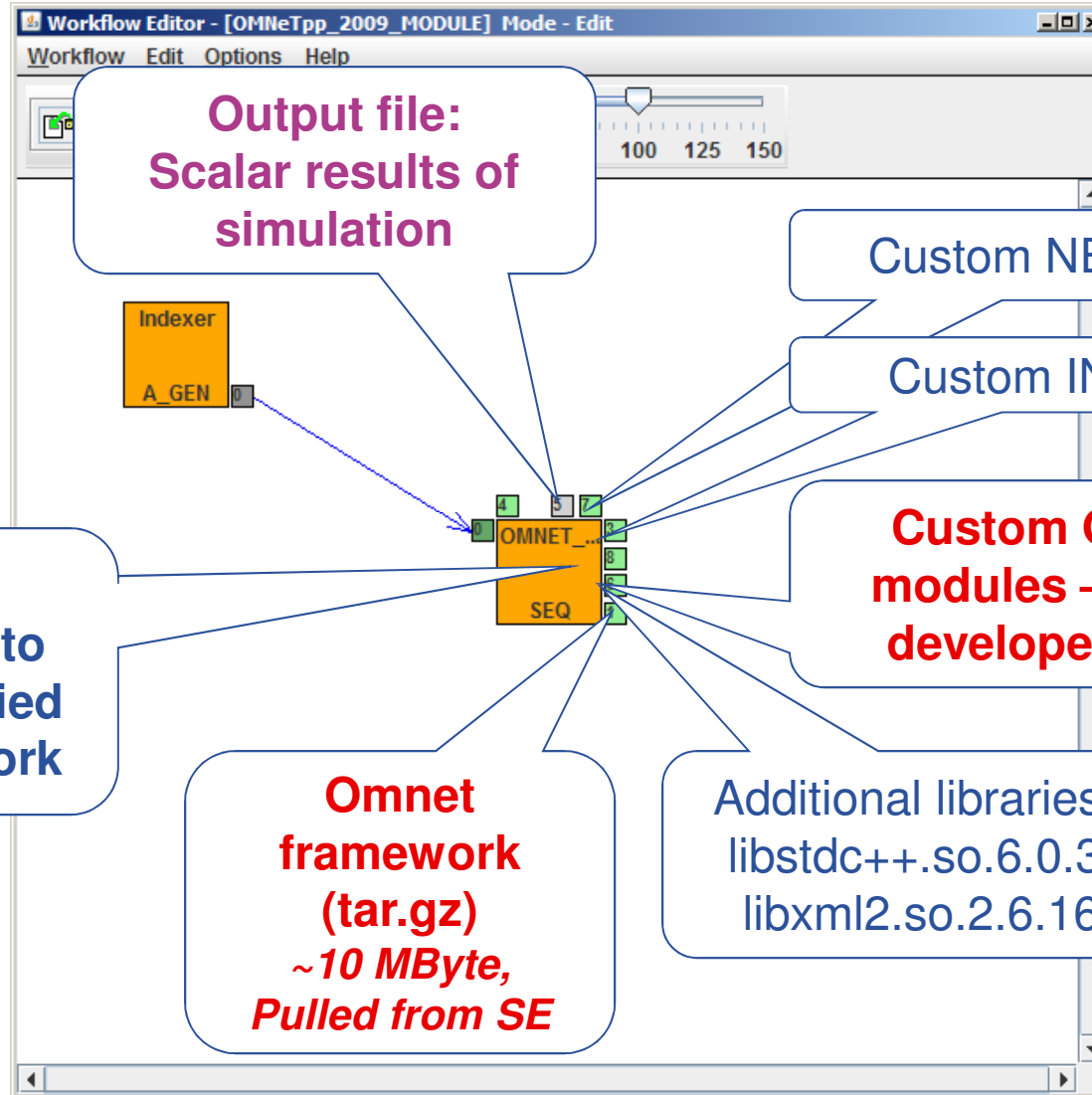




- Web based grid application development environment
- Support for
  - parameter sweep workflows
  - gLite and Globus middleware
- Open source tool:
  - <http://sourceforge.net/projects/pgportal/>
- Services:
  - Job management
  - Grid file management
  - Certificate management
  - Fault tolerant job execution in unreliable environments
- Porting roadmap for OMNET:
  - Compile and run OMNET framework with P-GRADE Portal
  - Development of OMNET portlet
    - Using the Application Specific Module of P-GRADE Portal





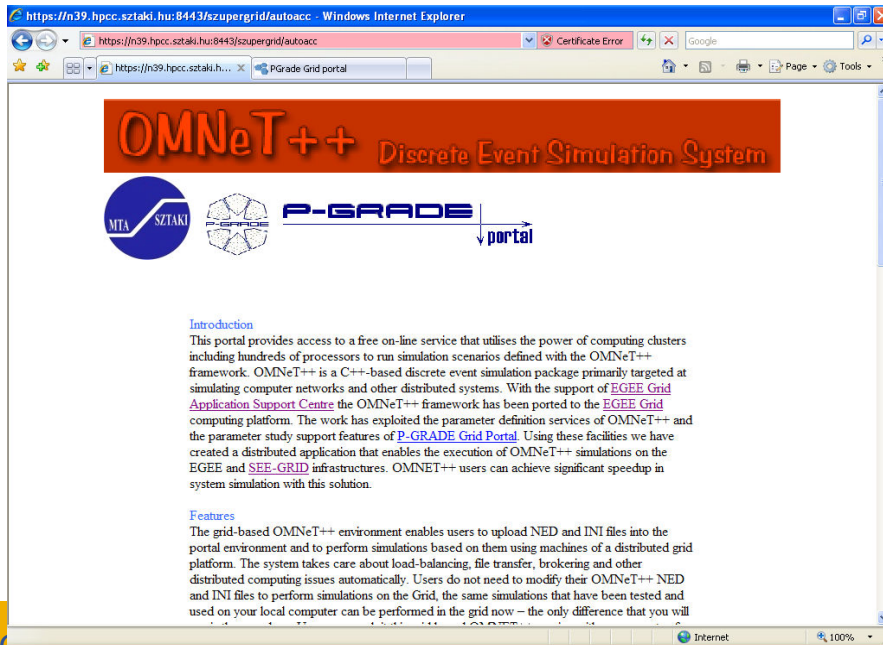


## OMNET user portal

- Automated account creation.  
Account exists for 1 week
- Only INET and Queuing modules in NED files
  - No binary comes from end user
    - Portal performs grid operations with a robot certificate
- In production:  
<https://pgrade-omnet.sztaki.hu>

## OMNET developer portal

- Permanent user accounts
- Any NED file
  - Binaries come from end users
    - Grid operations with the users' personal certificates
- Under development





https://n39.hpcc.sztaki.hu:8443/szupergrid/autoacc - Windows Internet Explorer

https://n39.hpcc.sztaki.hu:8443/szupergrid/autoacc Certificate Error gwendia

https://n39.hpcc.sztaki.h... PGrade Grid portal

# OMNeT++ Discrete Event Simulation System



portal

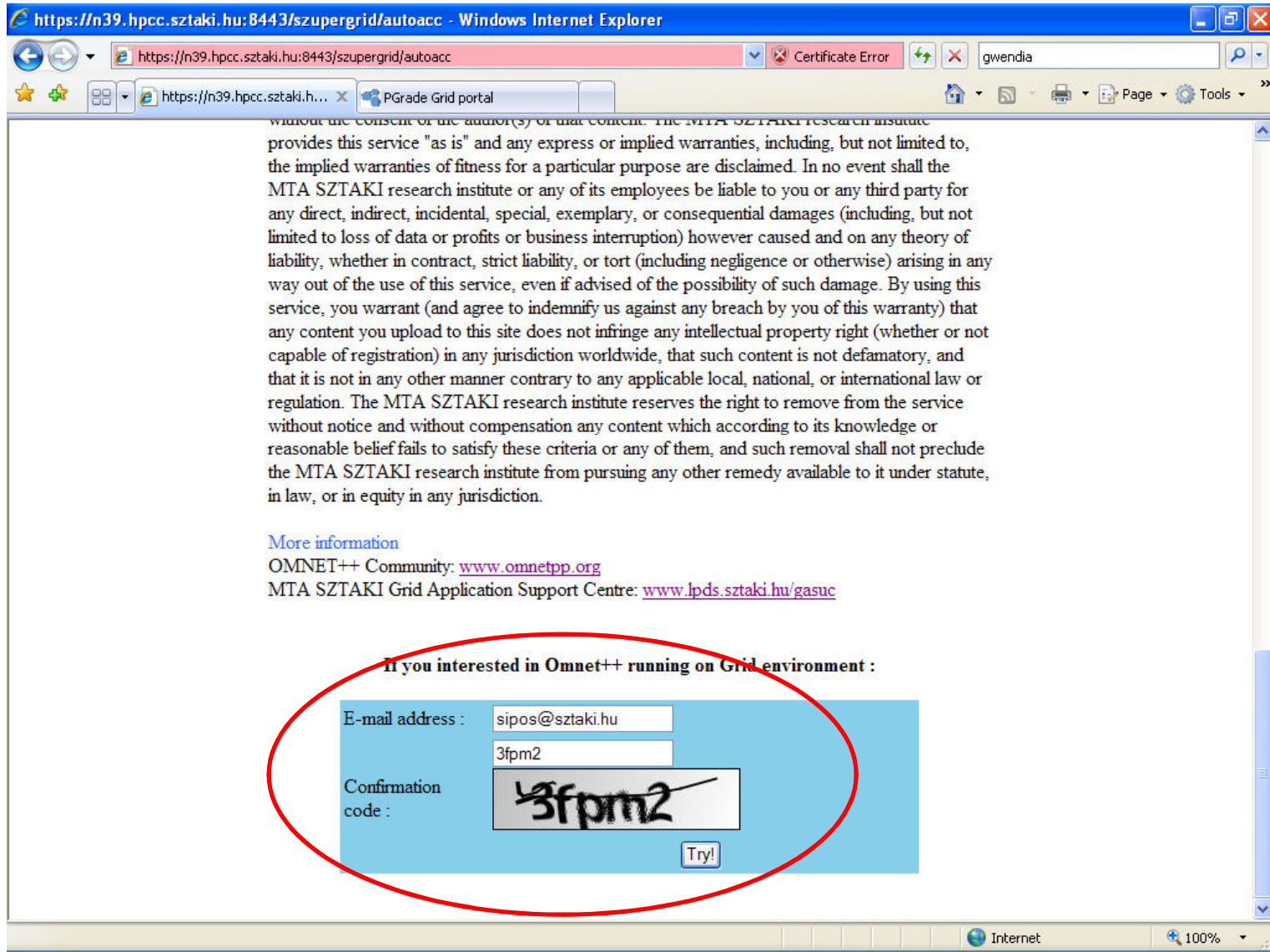
### Introduction

This portal provides access to a free on-line service that utilises the power of computing clusters including hundreds of processors to run simulation scenarios defined with the OMNeT++ framework. OMNeT++ is a C++-based discrete event simulation package primarily targeted at simulating computer networks and other distributed systems. With the support of [EGEE Grid Application Support Centre](#) the OMNeT++ framework has been ported to the [EGEE Grid](#) computing platform. The work has exploited the parameter definition services of OMNeT++ and the parameter study support features of [P-GRADE Grid Portal](#). Using these facilities we have created a distributed application that enables the execution of OMNeT++ simulations on the EGEE and [SEE-GRID](#) infrastructures. OMNeT++ users can achieve significant speedup in system simulation with this solution.

### Features

The grid-based OMNeT++ environment enables users to upload NED and INI files into the portal environment and to perform simulations based on them using machines of a distributed grid platform. The system takes care about load-balancing, file transfer, brokering and other distributed computing issues automatically. Users do not need to modify their OMNeT++ NED and INI files to perform simulations on the Grid, the same simulations that have been tested and used on your local computer can be performed in the grid now – the only difference that you will

Internet 100%

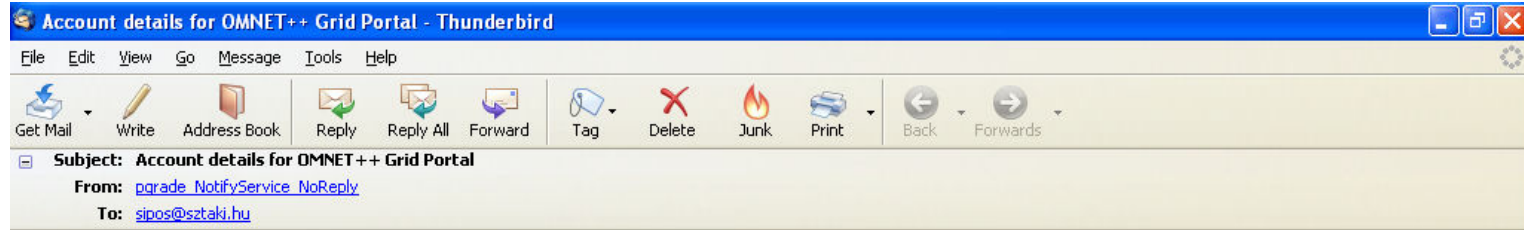


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[More information](#)  
 OMNET++ Community: [www.omnetpp.org](http://www.omnetpp.org)  
 MTA SZTAKI Grid Application Support Centre: [www.lpds.sztaki.hu/gasuc](http://www.lpds.sztaki.hu/gasuc)

**If you interested in Omnet++ running on Grid environment :**

E-mail address :   
  
 Confirmation code :



This automated email has been sent to inform you that an account has been prepared for you on the OMNeT++ Grid Portal. The account request has been submitted to us from the <http://portal.p-grade.hu/omnetdemo> page. If you are not the one who submitted the request then please inform us at [pgportal@lpds.sztaki.hu](mailto:pgportal@lpds.sztaki.hu).

To access your personal account on the OMNeT++ portal please follow this link:

[https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere/login/login/r/?gs\\_action=gs\\_login&username=8ade4826&password=8ade4826](https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere/login/login/r/?gs_action=gs_login&username=8ade4826&password=8ade4826)

Please note that the account is active for one week (from the date of creation) and can be used to execute one OMNeT++ simulation within that period on the Grid. Should you need access for longer than a week, or should you like to run more than one OMNeT++ simulations, please apply for additional accounts on the above page or contact us at [pgportal@lpds.sztaki.hu](mailto:pgportal@lpds.sztaki.hu).

Best regards,  
OMNeT++ Grid Service Administrators






PGrade Grid portal - Windows Internet Explorer



https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere?cid=97

Logout

RELEASE 2.7



**P-GRADE** portal

Notify Try OMNET project on GRID!

Notifications

**Email Settings:**

Enabled: Yes

Email Address: sipos@sztaki.hu

Email Subject: OMNET++ Measurement Notification

**Workflow Change Settings:**

Enabled: Yes

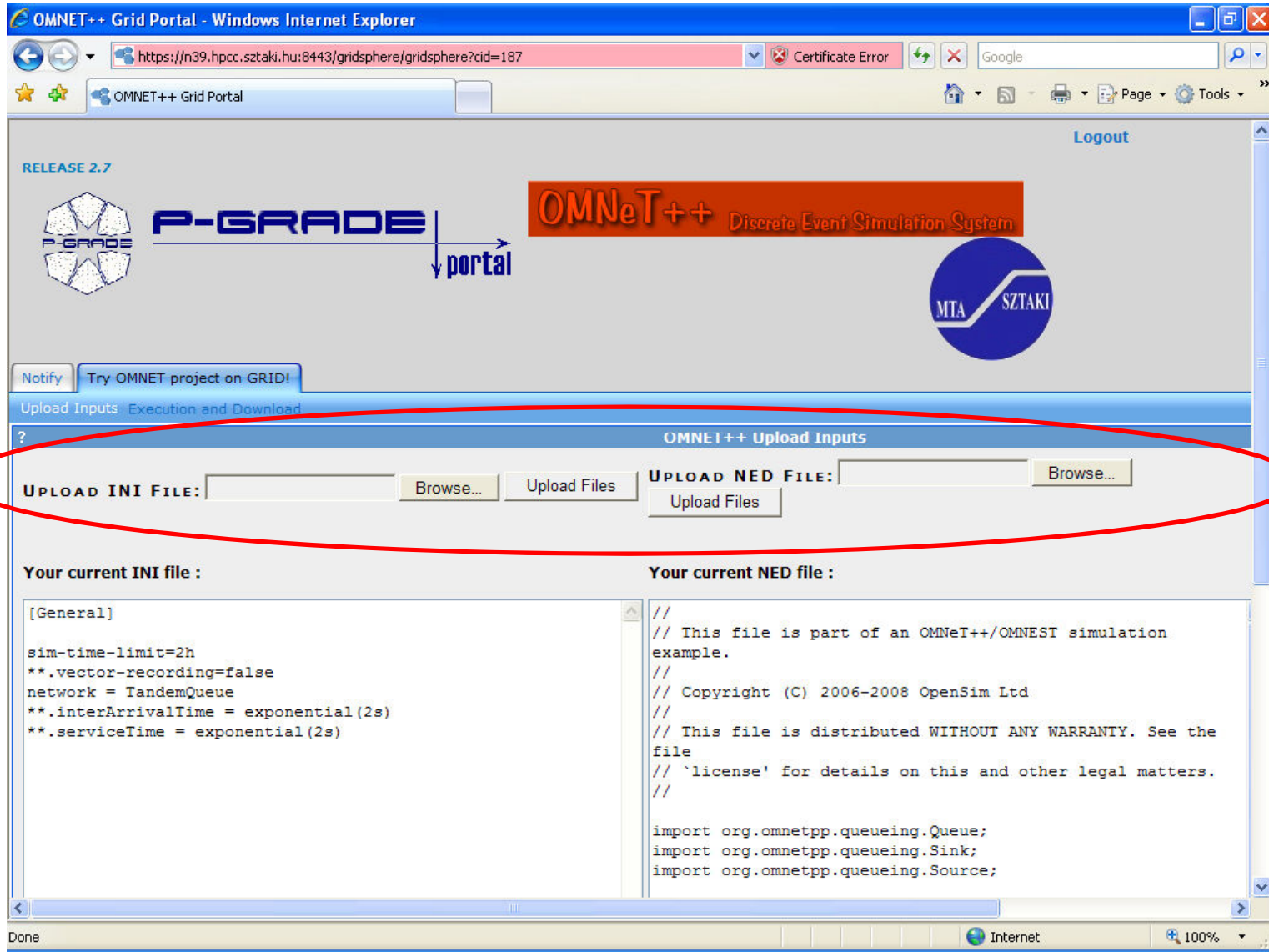
Message:

```
Dear User!

Your OMNeT++ simulation's status is changed in
job #job:
  old Status is : #oldstatus#
  new Status Is : #newstatus#
```

key list:  
 #now#  
 #user#  
 #portal#  
 #workflow#  
 #oldstatus#  
 #newstatus#  
 #details#

Internet 100%



OMNET++ Grid Portal - Windows Internet Explorer

https://n39.hpc.sztaki.hu:8443/gridsphere/gridsphere?cid=187

Logout

RELEASE 2.7

P-GRADE → portal

OMNeT++ Discrete Event Simulation System

MTA SZTAKI

Notify Try OMNET project on GRID!

Upload Inputs Execution and Download

? OMNET++ Upload Inputs

UPLOAD INI FILE:  Browse... Upload Files

UPLOAD NED FILE:  Browse... Upload Files

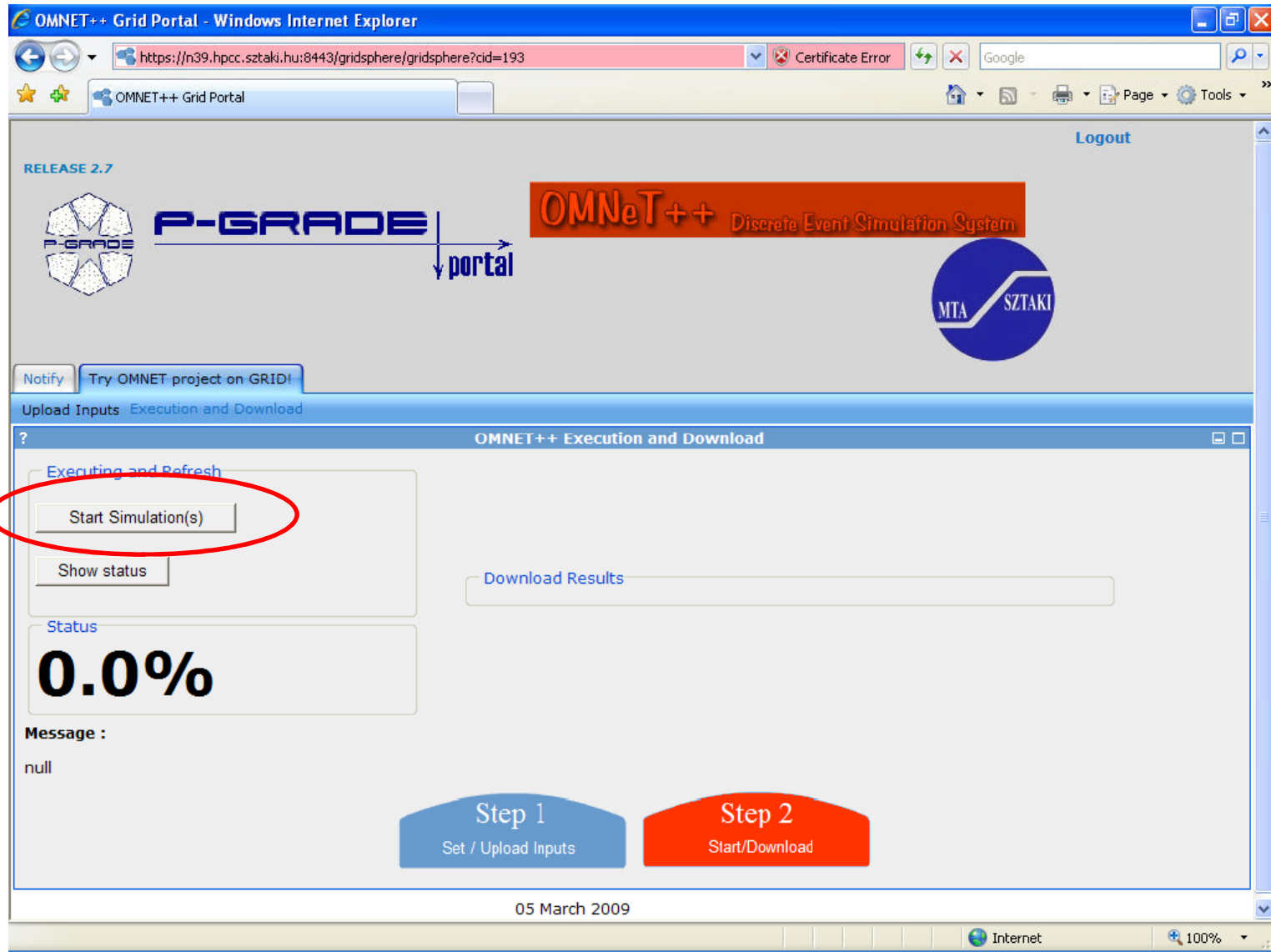
Your current INI file :

```
[General]
sim-time-limit=2h
**.vector-recording=false
network = TandemQueue
**.interArrivalTime = exponential(2s)
**.serviceTime = exponential(2s)
```

Your current NED file :

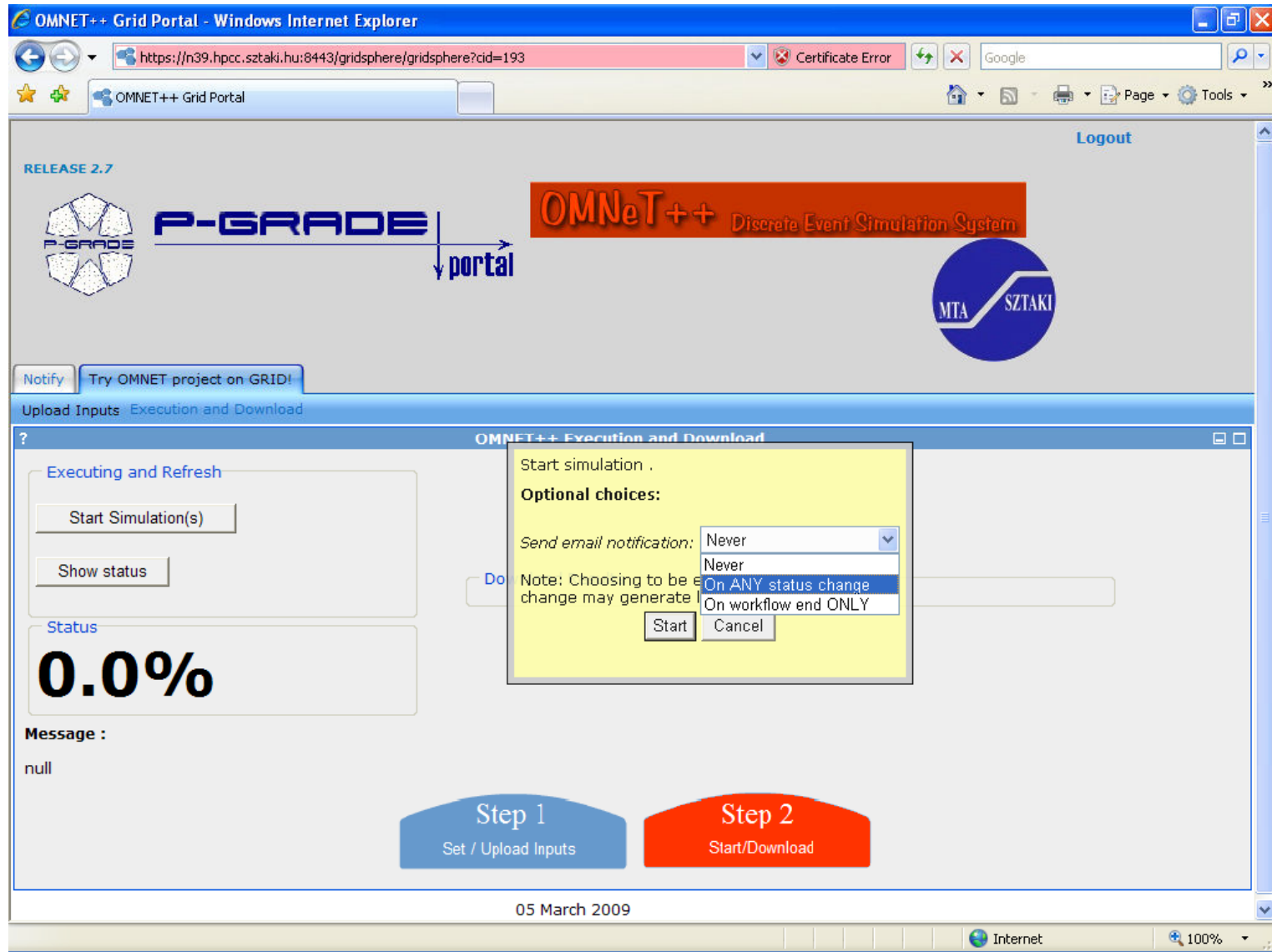
```
//
// This file is part of an OMNeT++/OMNEST simulation
// example.
//
// Copyright (C) 2006-2008 OpenSim Ltd
//
// This file is distributed WITHOUT ANY WARRANTY. See the
// file
// `license' for details on this and other legal matters.
//
import org.omnetpp.queueing.Queue;
import org.omnetpp.queueing.Sink;
import org.omnetpp.queueing.Source;
```

Done Internet 100%



The screenshot shows a web browser window titled "OMNET++ Grid Portal - Windows Internet Explorer". The address bar shows the URL <https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere?cid=193>. The page content includes:

- Top right: [Logout](#)
- Left side: "RELEASE 2.7" and a logo for "P-GRADE".
- Center: "OMNeT++ Discrete Event Simulation System" in a red banner, with "portal" written below it.
- Right side: MTA and SZTAKI logos.
- Navigation: "Notify" and "Try OMNET project on GRID!" buttons.
- Menu: "Upload Inputs" and "Execution and Download".
- Section: "OMNET++ Execution and Download" with a "Executing and Refresh" link.
- Buttons: "Start Simulation(s)" (circled in red), "Show status", and "Download Results".
- Status: "Status" section showing "0.0%".
- Message: "Message : null".
- Progress: "Step 1 Set / Upload Inputs" (blue button) and "Step 2 Start/Download" (red button).
- Footer: "05 March 2009" and "Internet 100%".



OMNET++ Grid Portal - Windows Internet Explorer

https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere?cid=193

Logout

RELEASE 2.7

P-GRADE → portal → OMNeT++ Discrete Event Simulation System

MTA SZTAKI

Notify Try OMNET project on GRID!

Upload Inputs Execution and Download

OMNET++ Execution and Download

Executing and Refresh

Start Simulation(s)

Show status

Status

**0.0%**

Message : null

Start simulation .

Optional choices:

Send email notification: Never

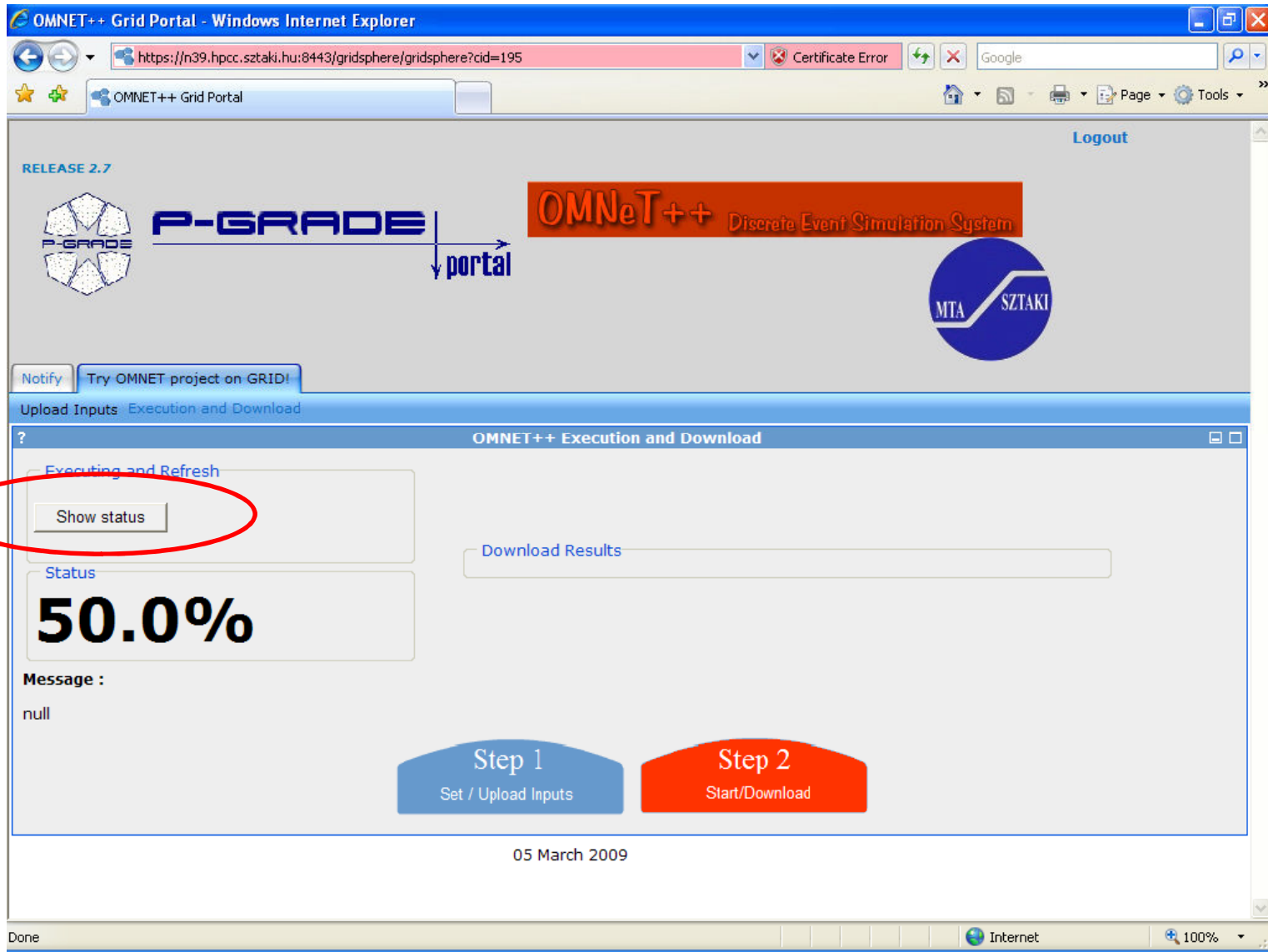
Note: Choosing to be e change may generate

Start Cancel

Step 1 Set / Upload Inputs

Step 2 Start/Download

05 March 2009



The screenshot shows a web browser window titled "OMNET++ Grid Portal - Windows Internet Explorer". The address bar shows the URL <https://n39.hpc.sztaki.hu:8443/gridsphere/gridsphere?cid=195>. The page content includes a "Logout" link in the top right, a "RELEASE 2.7" notice, and logos for "P-GRADE" and "OMNeT++ Discrete Event Simulation System". A diagram shows "P-GRADE" with an arrow pointing to "portal". The MTA and SZTAKI logos are also present. A navigation bar contains "Notify" and "Try OMNET project on GRID!". Below this, there are tabs for "Upload Inputs" and "Execution and Download". The main content area is titled "OMNET++ Execution and Download" and contains a "Executing and Refresh" section with a "Show status" button circled in red. A "Status" box displays "50.0%". A "Download Results" input field is also visible. At the bottom, there are two buttons: "Step 1 Set / Upload Inputs" and "Step 2 Start/Download". The date "05 March 2009" is shown at the bottom center. The browser status bar at the bottom indicates "Done" and "Internet" with a 100% zoom level.


OMNET++ Grid Portal - Windows Internet Explorer

https://n39.hpcc.sztaki.hu:8443/gridsphere/gridsphere?cid=195


OMNET++ Grid Portal

Logout

RELEASE 2.7

 **P-GRADE** → portal

**OMNeT++** Discrete Event Simulation System



Notify Try OMNET project on GRID!

Upload Inputs Execution and Download

**OMNET++ Execution and Download**

Executing and Refresh

Show status

Status

**100.0%**

Message :  
null

Download Results

**File Browser**

| Select                   | Name                            | Size(bytes) | Date         |
|--------------------------|---------------------------------|-------------|--------------|
| <input type="checkbox"/> | outputs.tar.858902b6_Instance.1 | 10240       | Mar 05 12:39 |

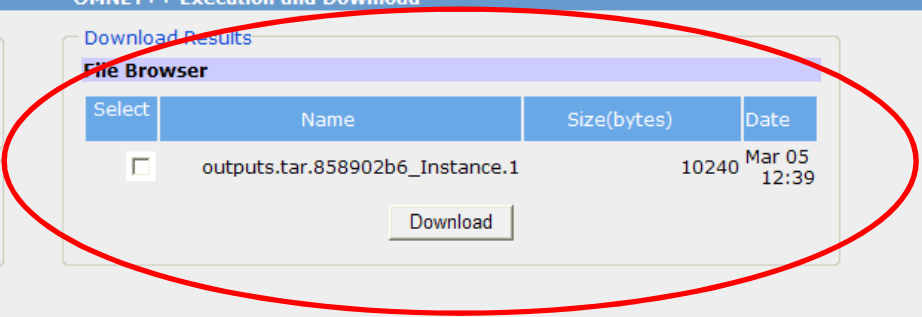
Download

Step 1 Set / Upload Inputs

Step 2 Start/Download

05 March 2009

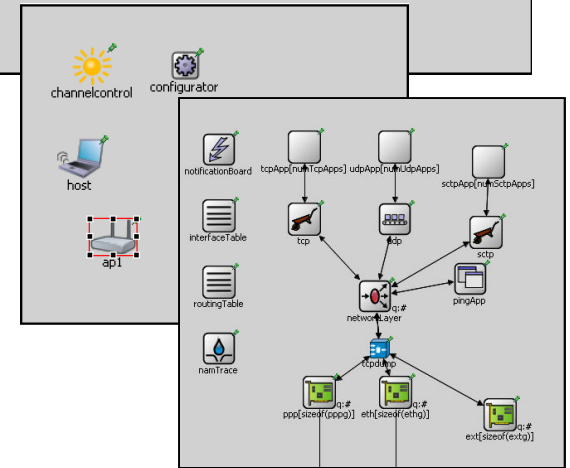
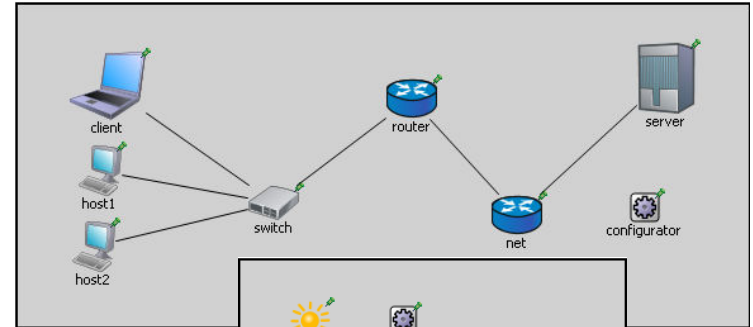
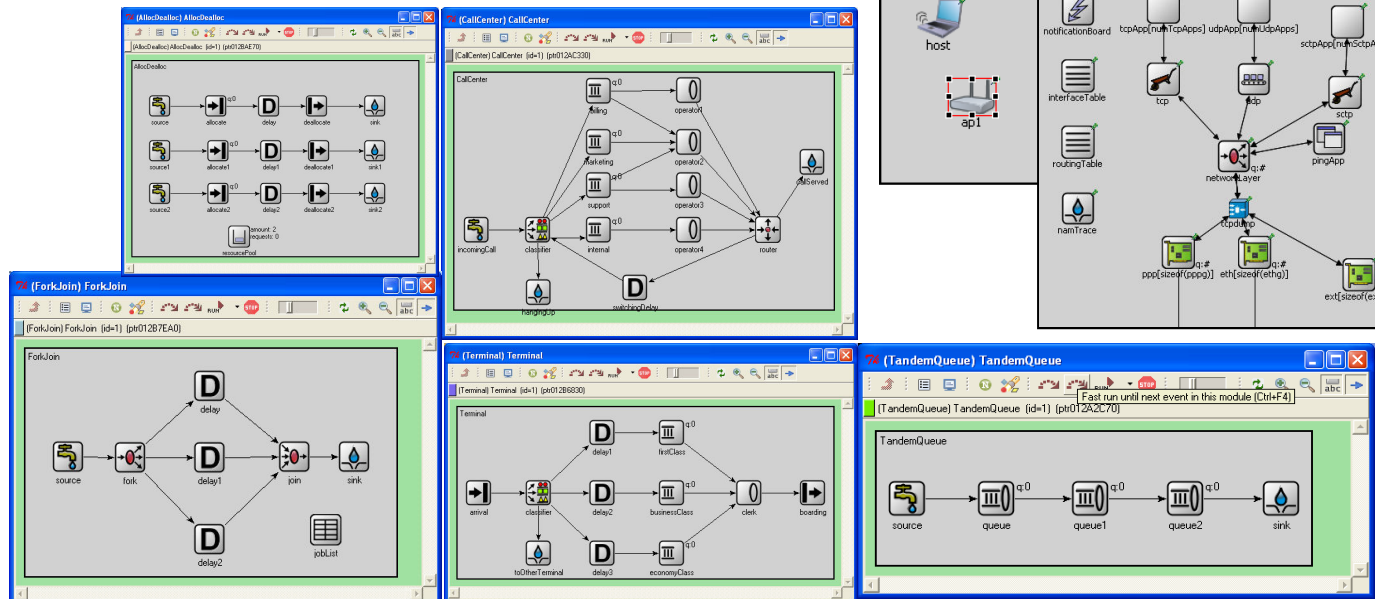
Internet 100%




- **INET Framework**

- **TCP/IP based wired and wireless networks:** TCP, UDP, IP, IPv6, IEEE 802.11, Ethernet, MPLS, ...
- several contributors


- **Queuing Framework**

RELEASE 2.7 Logout



**P-GRADE** portal



Certificates OMNET project

Certificate Manager

Certificate list

| Issuer  | Set for Grids                   | Time left | [Actions]   |
|---|---------------------------------|-----------|---|
| C=HU,O=NIIF CA,OU=GRID,OU=ELTE IK,CN=Balasko Akos,E=akos0215@freemail.hu,CN=proxy | seegrid<br>seegrid_GLITE_BROKER | 99:59:27  | <a href="#">Details</a>   <a href="#">Set for Grid</a>   <a href="#">Delete</a> |

[Refresh](#)

[Download](#) (Download certificate from MyProxy server.)      [Upload](#) (Upload authentication data to MyProxy server.)


[Credential Management](#) (Display information, change MyProxy passphrase, remove a credential from MyProxy server.)

**Message:** Certificate successfully set for seegrid.

February 23, 2009




RELEASE 2.7 Logout



## P-GRADE

portal



Certificates **OMNET project**

Measurement Manager Upload Inputs Execution and Download

? OMNET++ Measurement Manager □ □

**Message :**

Available Instances

| Select                | Name       |
|-----------------------|------------|
| <input type="radio"/> | 17_02_09_m |
| <input type="radio"/> |            |
| <input type="radio"/> |            |
| <input type="radio"/> |            |
| <input type="radio"/> |            |

**CREATE NEW INSTANCE**

Published Applications : OMNET\_MODULE\_2009\_SEEGRID

Name : demo\_new      Description : demo

Submit    Cancel

Step 1  
Create/Load/Delete Instances

Step 2  
Upload / Set Inputs

Step 3  
Execute/Download

February 23, 2009

RELEASE 2.7



**P-GRADE** portal



Logout

Certificates OMNET project

Measurement Manager Upload Inputs Execution and Download

### OMNET++ Upload Inputs

Message :

CURRENT INSTANCE IS : DEMO\_NEW

UPLOAD INI FILE:  Browse... Upload Files

UPLOAD NED FILE:  Browse... Upload Files

UPLOAD MODULE FILE (TARRED):  Browse... Upload Files

Set runs

Step 1: Create/Load/Delete Instances

Step 2: Upload / Set Inputs

Step 3: Execute/Download

February 23, 2009

- **Most porting projects must produce a grid portal**
  - Interface for non IT people
    - Automated handling of grid errors
    - ...
- **Application specific module for P-GRADE Portal**
  - Provides an API on top of Gridsphere and P-GRADE core services
    - Only a few Java classes to learn!
    - Connect **any Web interface** to your application through this
  - **No need to learn** P-GRADE and Gridsphere programming
- **Examples:**
  - OMNET simulation portals (1 novice, 1 advance)
  - Numerical Modeling of Mantle Convection portal
  - E-marketplace Model Integrated with Logistics

- **“Application specific module” for P-GRADE Portal**
  - Hide your grid from end users
  - Expose grid applications as software services
    - Build on P-GRADE core services & Gridsphere portal services
  - Success stories from various communities
    - OMNET++ simulation community
    - Earth science (mantle convection)
    - Logistics (optimization)
- **OMNET portal in production:**
  - <https://pgrade-omnet.sztaki.hu>

# Questions?

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**[www.lpds.sztaki.hu/gasuc](http://www.lpds.sztaki.hu/gasuc)**